

Natalia Ślusarz

PHD STUDENT

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Education

Heriot-Watt University

PHD IN COMPUTER SCIENCE

[Edinburgh, UK](#)

Sept. 2021 - PRESENT

- My thesis focuses on the intersection of ML and formalisation - I investigate a method of property-based NN training, differentiable logics, by applying a more rigorous approach and theorem provers (Coq and MathComp)
- I have worked on the development of this training method in a Haskell-based NN verification tool - Vehicle

Heriot-Watt University

BSC. (HONS) IN MATHEMATICS AND COMPUTER SCIENCE

[Edinburgh, UK](#)

Sept. 2017 - Jun. 2021

- **Topic:** "Mathematical Properties of Neural Networks Trained on Artificial Data Sets"
- Finished with First Class Honours
- My thesis focused on mathematical properties of neural networks, investigating the influence of complexity of data on the behaviour of the learnt NN representation

University of Science and Technology AGH

COMPUTER SCIENCE

[Kraków, Poland](#)

Sept. 2016 - Jul. 2017

- After a year moved to a different degree to involve a more mathematical approach to computer science

Experience

Research Assistant

HERIOT-WATT UNIVERSITY

[Edinburgh, UK](#)

Dec. 2024 - Apr. 2025

- Worked as part of a project AISEC (AI Secure and Explainable by Construction)
- My work was closely tied with my PhD and focused on providing a formalisation of Differentiable Logics, a neural network training method being implemented in the verification tool Vehicle (which has been developed as part of the AISEC project)

Teaching Assistant

HERIOT-WATT UNIVERSITY

[Edinburgh, UK](#)

Sept. 2021 - Dec. 2023 (intermittently)

- Delivered labs in multiple subjects ranging from ML, through programming languages to academic writing: Data Mining and Machine Learning, Advanced Software Engineering, Software Development, Research Methods and Project Planning
- Assessed students' coursework and lab projects, advised on Master's projects

Research Associate

HERIOT-WATT UNIVERSITY

[Edinburgh, UK](#)

Oct. 2021 - Mar. 2022

- Worked as a part-time RA on a research project "Neural Network Verification: in search of the missing spec"
- The goal of this project was to address the current under-defined semantics of neural networks. My responsibilities focused around identifying methods from other research areas that could be applied for the purposes of neural networks

Intern in Technology Research and Development

PWC POLAND | FINANCIAL CRIME UNIT

[Gdynia, Poland](#)

Jun. 2021 - Aug. 2021

- Worked on tool development in the Research and Development Technology team and improved the tool's performance by using neural networks to meet industry standards
- Contributed towards implementing modern machine learning solutions in new internal tools

Skills

Programming	Rocq, MathComp, Python (including PyTorch and TensorFlow, Haskell, JAVA, C++, C, LaTeX, MATLAB, PolyML, SML, PROLOG)
Machine learning	Well-versed in mathematical approaches to machine learning and property-based training methods
	Good knowledge of neural network verification
Mathematics	Familiarity with logic research, general knowledge of university mathematics
	Experienced in mechanisation of proofs and ITPs
Languages	Polish (Native), English (Fluent) , German (Basic)

Chosen Publications - Full list available on Google Scholar

Taming Differentiable Logics with Coq Formalisation

WITH REYNALD AFFELDT, ALESSANDRO BRUNI, EKATERINA KOMENDANTSKAYA, KATHRIN STARK

ITP

2024

- Describes formalisation of different DLs and the proofs of their properties in Coq and MathComp
- Recovers erroneous or missing proofs from existing literature, revises semantics of existing DLs to make them amenable towards verification.

A Neurosymbolic Framework for Bias Correction in CNNs

WITH PARTH PADALKAR, GOPAL GUPTA, EKATERINA KOMENDANTSKAYA

ICLP

2024

- Introduces a neurosymbolic framework called NeSyBiCor for bias correction in a trained CNN based on desirable or undesirable concepts present in CNN filters

Logic of differentiable logics: Towards a uniform semantics of DL

WITH EKATERINA KOMENDANTSKAYA, MATTHEW DAGGITT, ROBERT STEWART, KATHIN STARK

LPAR

2023

- Introduces a meta-DL - a combination of typed syntax and semantics able to generically express different differentiable logics.
- Suggests an extension of the existing syntax with a probabilistic approach to quantifiers.

Other Academic Activities

ITP 2026

PUBLICITY CHAIR

Lisbon, Portugal

2026

- In charge of communication with conference attendees and PC members, as well as maintaining the conference website

Rocqshop 2025

PROGRAM COMMITTEE MEMBER

Iceland

2025

- Reviewed abstract submissions for the workshop (previously known as Coq Workshop)

Quantitative Logic Reading Group

CO-ORGANISER

University of Southampton, UK

2024-2025

- Co-organised a series of reading group seminars related to quantitative logic, held in a blended format
- Was in charge of leading the discussions and organisational matters

LAIV (Lab for AI and Verification)

MEMBER AND VOLUNTEER

UK

Sept 2020 - PRESENT

- Gained expertise in AI verification, especially related to neural networks. Had an opportunity to present and discuss my work with other experts in my field
- Provided help with organisation of a seminar series by taking over the seminar schedule and notifications, as well as management of the seminar-wide mailing list

Theorem Proving and Machine Learning in the age of LLMs: SoA and Future Perspectives

VOLOUNTEER

Heriot-Watt University, UK

April 2025

- Coordinated the online stream of the workshop as well as handled the technical setup and testing

Workshop on Safe and Robust Machine Learning

VOLOUNTEER

Heriot-Watt University, UK

October 2023

- Helped with organisation of the local venue and technical setup

Mathematical Components School and Workshop

ATTENDEE

INRIA in Sophia-Antipolis, France

December, 2022

- Introduces the SSReflect proof language and the Mathematical Components library - a repository of formalized mathematical theories based on the Coq proof assistant

Scottish Programming Languages and Verification Summer School

VOLOUNTEER

Heriot-Watt University, UK

July 2022

- Was in charge of registration of the summer school participants
- Handled the technical setup of the lectures, especially the coordination of the live stream delivered in a blended format